Alternative model for partitioning among ice, liquid, and gas phases.

The following representation avoids the need for iteration to obtain ice and unfrozen water content. The freezing temperature is approximated as

$$T_f = T_0 - \frac{1}{\beta} \frac{T_0}{L_f \rho_l} \psi_* \left(1 - s_g\right)$$

where β is the 2.2 for non-colloidal soils and 1.0 for colloidal soils, T_0 is 273.15 K, L_f is the heat of fusion for water ice (3.34×10^5 J/kg), ρ_l is the density of water (999.8 kg/m^3), and $\psi_*(\ )$ is the capillary pressure function (Pa).

If $T < T_f$, then

$$s_l = S_* \left(-\beta \rho_l L_f \vartheta\right)$$

$$s_i = 1 - \frac{s_l}{S_* \left(p_g - p_l\right)}$$

we also require $p_l \geq p_g + \beta \rho_l L_f \vartheta$ as more negative values of liquid pressure

would result in $s_i < 0$.

If $T \geq T_f$ then

$$s_l = S_* \left(p_g - p_l\right) \text{ and } s_i = 0.$$

where $\vartheta = \dfrac{T - T_0}{T_0}$.